Test Report

Solar Cooling Unit

Phaesun SelfChill MT 75

University of Hohenheim
Institute of Agricultural Engineering
Agricultural Engineering in the Tropics and Subtropics
Garbenstr. 9, 70599 Stuttgart, Germany
Info440e@uni-hohenheim.de

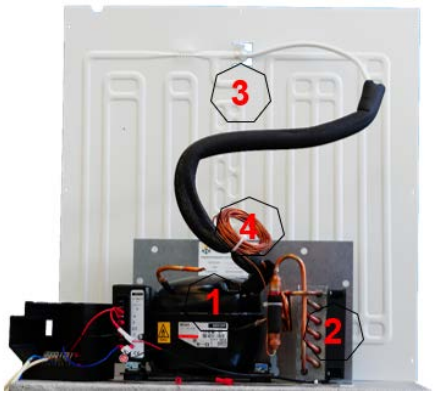
1 Objective

Test the performance of the specific cooling unit in water bath under controlled laboratory conditions, described as the coefficient of performance (COP) and/or the produced amount of ice per day.

Taken measures:		
	Time	Agilent Logger (Type K Sensors)
	Water temperature	Agilent Logger (Type K Sensors)
	Evaporator temperature	Agilent Logger (Type K Sensors)
	Suction line temperature	Agilent Logger (Type K Sensors)

2 Tested Product

Product description	Solar Cooling Unit Phaesun SelfChill MT 75
Article Number:	321818



Components	Description
1. Compressor	Danfoss hermetic system, DC- powered
2. Condenser	Compact HX, with aluminum fins on copper tubes and integrated fan
3. Evaporator	Two plates bonded together. The area which is not bonded forms the evaporator channel.
4. Refrigerant charge and capillary tube	Experimentally optimized

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3 Experimental setup

Test Engineer:	Dr. Victor Torres Toledo	
Place:	Solar Cooling Testing Facilities of the University of Hohenheim	
Start:	07.11.2018	19:00
End:	08.11.2018	13:30

Serial Configuration Cooling Unit(s):

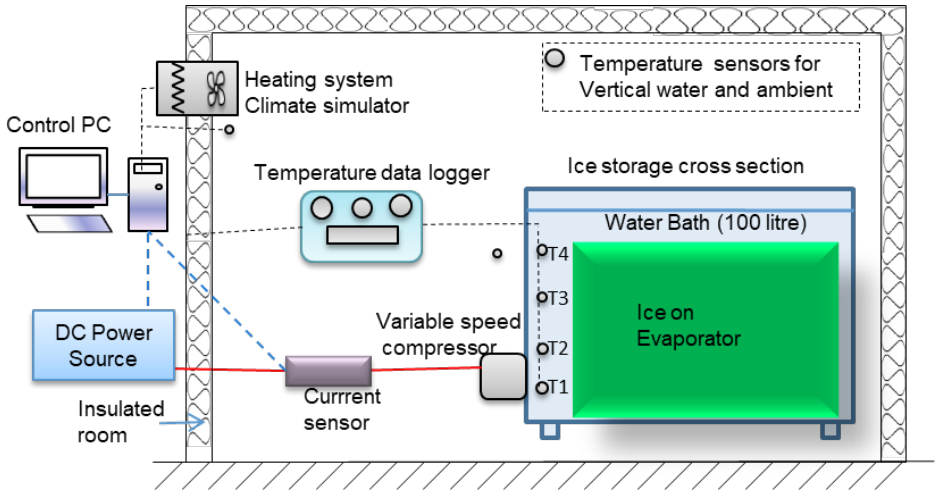
Amount of Refrigerant R-600a:	35 g
Capillary Tube – inner diameter:	0.7 mm
Capillary Tube – length:	4 m

Conditions:

Ambient Temperature:	30	°C
Voltage:	24	V DC
Amount water:	100	l

Sensor positions:

1. Evaporator plate cold area
2. Evaporator plate warm area
3. Water bath top
4. Water bath bottom
5. Suction line compressor entrance



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The evaporator plate of a DC powered cooling unit with a certain geometric configuration was placed in the middle of a fully insulated (100 mm polystyrene) water bath.
The setup was placed in a climate chamber where a constant temperature was applied.
The compressor was powered by a DC power source with 24 V.
Temperature measurement were done with an Agilent Data Logger and type K temperature Sensors.

Figure 1: The experimental setup of the evaporator plate

4 Calculations

COP was calculated with the following formula:

$$COP = \frac{Q_T + Q_C}{Q_e} = \frac{\frac{\lambda}{d} A \Delta T_I t + \Delta T_t m c_w}{UIt}$$

where

λ: specific conductivity insulation material

d: insulation thickness

A: insulation area

ΔT_I: temperature difference water:ambient

t: time of cooling

ΔT_t: temperature difference water t_0:t_1

m: amount of water

c_w: specific heat capacity of water

U: Voltage

I: Current

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5 Results

5.1 Temperature Measurements

The data of the temperature measurements were plotted over the time (Figure 1).

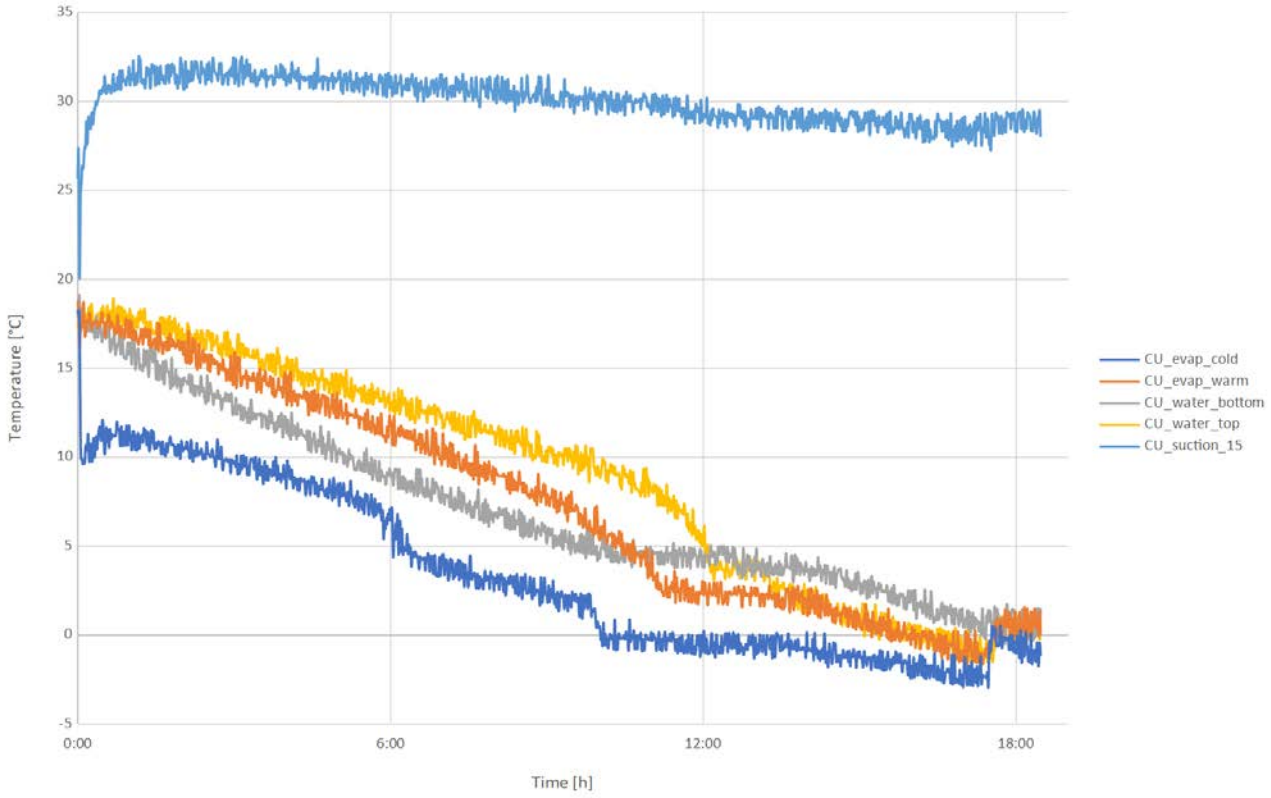
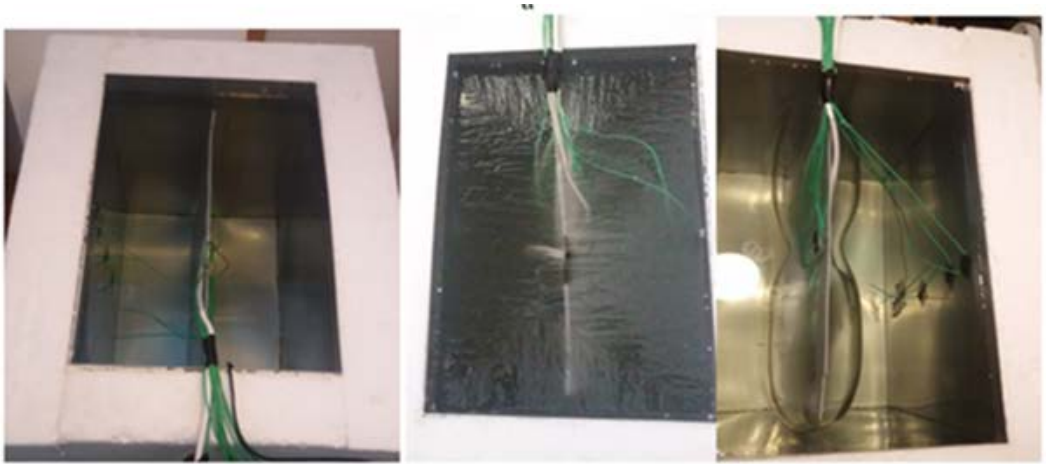


Figure 1: *Temperature data of the experiment, where the blue line (CU_evap_cold) shows the temperature of the cold area of the evaporator, the red line (CU_evap_warm) shows the temperature of the warm area of the evaporator, the grey line (CU_water_bottom) shows the water temperature at the bottom of the water bath and the yellow line (CU_water_top) shows the water temperature at the top of the water bath. The second blue line (CU_suction_15) shows the temperature of the suction line at the entrance to the compressor.*



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5.2 COP-Calculations

$$\lambda = 0.0400 W m^{-1} K^{-1} \qquad \Delta T_t = 18.1 K$$

$$d = 0.100 m \qquad m = 100 kg$$

$$A = 1.36 m^2 \qquad c_w = 1.16 Whkg^{-1} K^{-1}$$

$$\Delta T_I \approx 21.1 K \qquad U = 24.0 V$$

$$t = 17.5 h \qquad I = 2.90 A$$

COP *(cool down)* **= 1.89**

5.3 Summary

The Solar Cooling Unit has **passed the test successfully**.

The COP is in the expected range.

The Measured temperatures and duration are in the expected range.

Dr. Victor Torres Toledo
University of Hohenheim | Institute of Agricultural Engineering | Tropics and Subtropics Group (440e)
Garbenstr. 9, 70599-Stuttgart, Germany
Mail: victor.torrestoledo@uni-hohenheim.de